



M.S-9

Date of Pingala -

### The Origin of Binary Computation in India

K. V. Ramakrishna Rao, B.Sc., M.A., A.M.I.E., C.Eng.(I),  
B.L., 25 (Old.9), Venkatachala Iyer Street,  
West Mambalam, Chennai – 600 033.

**Introduction:** With the advent of Binary numbers, Binary computation and their application to logical circuitry in Computers have focussed importance to the history of "Binary Numbers" and modern scholars<sup>1</sup> have traced them to Pingala, the ancient Prosody expert of India. Indian Prosody is not just versification or speech-rhythms, but the complete technology of poetry with metrics, metre with syllables, syllables with sound, sound with vibration, vibration with desired effect and the effect useful to man and the rules made thereof. At one side, Indians have been accused of lack of historical sense, not having script, not keeping historical records, and so on, but at other side, some times, they are also praised. Here, the basis of Prosody and its connection with music and mathematics and the evolution of binary numbers thereof are analyzed based on the Chanda sutras. As chronology is the connected factor, it is also linked with the evolution of Indian thinking, thought processes, philosophy, mathematical methodology adopted behind such operations. The English translation of Anunduram Borooah (1850-1889) of *Pingala Chanda Sutras* (1877) is used in this paper, wherever quoted and adopted<sup>2</sup>.

**Language and Script:** The concept of language and script is different and it is not necessary that a language should have a script for writing and write to learn language. Language is for speakers and script for writers. If a speaker is a speaker, he does not require any script, but a writer always requires a script. If a listener is a listener, he also does not require a script to record and read again. There are languages without script and scripts without languages. A script is used for more than one or several languages also. Therefore, age long usage of a language cannot be underestimated on the plea of "scriptless language".

**The Concept of Script:** Indian system of writing is connected with the concept of "Akshara", that is the one that cannot be destroyed, made to disappear or rubbed off. Thus, "Aksharam" is a word, syllable and number, always connected with eternity, completeness and absoluteness. Where, how, when, by whom and for whom such indestructible, unerasable or permanent writing can be invented, devised and written?

- Ø Where – the surface, place or medium should be there, where it could be written,
- Ø how – it has to be written by hand by some means of scribing - stylus, pen etc.
- Ø when – naturally, when requirement or necessity arises, writing must have been resorted to
- Ø by whom – who requires or wants it to be written, as otherwise, he may not be able to remember, recollect, recall, retrieve any data and information.

Ø and

Ø for whom – for himself or others.

As during Vedic period, such contingency did not arise, how the Vedic people could have promoted, protected and preserved the Vedas for their progeny. As has been claimed, was it possible for them to keep sakas / groups of experts to recite particular hymns forever or continuously, so that the continuity could have continued without any break, change, deviation or distortion? When western scholars started gathering the manuscripts of Vedic Sciences, perhaps dating back to 16<sup>th</sup> century, they found out that the earlier ones belonged to first centuries, as the written documents were in the form of tala (palm) patra and other leaves. Therefore, the written manuscripts, because of their nature wilted away and new manuscripts prepared, just like 100 years old book getting wilted and reprinted. But, the Vedas recorded in the minds continued.

In the context of Chandas, a syllable is an "Akshara", it may be a letter or letters. Accordingly, it may a vowel or vowel with consonant. A syllable may be **Guru** (heavy) or **Laghu** (light) depending upon such vowel-consonant combination.

A syllable is be **Guru** (heavy) if it contains a long vowel or a short vowel followed by a conjunct consonant or visarga or anusvara, as the pronunciation is protracted in all such cases.

It is **Laghu** (light) if it contained a short vowel not followed by a conjunct consonant or visarga or anusvara, as the pronunciation is not protracted in all such cases.

While discussing about Jatis, two classes are mentioned as *Matrachandah* and *Aksharachandah*. Therefore, the written down script comes next, as more importance is given to matra / sound based Chandas.

**Vedas are for Chanting:** Vedic hymns are chanted as they are meant for intonation. It is just like transmission and reception. In the case of Vedic hymns, the Language Experts have devised methodology to make the transmission and reception the same without any interference, distortion or deviation. There is a proverb, which asserts, "*the more you sing, the more the melody*", that is repetition is emphasized for perfection avoiding or removing distortion. The same method is used in teaching and learning mathematics or music as all involve mode of thinking in tones / scales.

Language is thinking in syllables and words. Mathematics is thinking in numbers and combination of numbers. Music is thinking in tones and scales. And all these three have the same fundamentals as common in working. In chanting Vedas all the are combined.

The processes involved are:

1. Identifying the syllables / numbers / notes: In learning a language, mathematics or music, the single syllable is identified by listening to it from the speaker or teacher.





2. Pronouncing them correctly: Pronouncing and repetition of pronouncement.
3. Formation of combination of the syllables / numbers / notes: Adding one syllable to another, another to other with different permutation and combinations. Thus, possibilities of formations are understood.
4. Vocalizing them: The different forms are also repeated continuously.
5. Memorizing: Thus, repetition leads to memorizing without defects.
6. After learning, following the timing: After the completion of learning process, the time scale is followed. In fact, that is already achieved in the earlier steps. However, as timings are specified, they are followed and systematized.

**Learning Process involved Sound**: Think about the learning process of a child. She learns through language, specifically, through speech, sound that is perfected. If she hears or listens to correct sound, she learns correct speech or language.

**Syllables, Metres etc**: In poetic context, the important words and expressions are defined as follows:

The table gives how many syllables, each chanda has:

Chanda	Gayatri	Vushnika	Anustup	Bruhati	Padavti	Tristup	Jagati
Deivi	1	2	3	4	5	6	7
Asuri	15	14	13	12	11	10	9
Prajapatya	8	12	16	20	24	28	32
Yajushi	6	7	8	9	10	11	12
Samni	12	14	16	18	20	22	24
Arco	18	21	24	27	30	33	36

The following table gives the details for Brahmi and Arshi metres:

Chanda	Gayatri	Vushnika	Anustup	Bruhati	Padavti	Tristup	Jagati
Brahmi	36	42	48	54	60	66	72
Arsho	24	28	32	36	40	44	48

1. Chanda Sastra / Chandovicit / Chandah (chanda = metre) treats the laws of versification.
  2. Padhya / Kavita (poetry) is the expression of composition coming out spontaneously regulated by harmonious arrangement of syllables pleasing to the ear and reaching the heart of others.
  3. Such arrangements is known as Vrutta (rhythm).
  4. It depends on harmonious succession of syllables, combination of syllables (words) comfortable to pauses due to the flow of syllables. Such form of succession is known as Chanda.
  5. Regulated verse combination is known as Jati (class).
  6. According to the flow of syllables, the metres are classified as –
- v Drutta = quick
  - v Madhya = mean
  - v Vilambit = slow
  - v Druttamadhyā = partly quick and partly slow.
  - v Druttavilambit = partly mean and partly slow.

These are only illustrative.

In Chapter II, Pingala describes the number of metres:

1. There are seven chandas (metres) – Deivi, Asuri, Prajapatya, Yajushi, Samni and Arco.
2. Each Chanda has number of syllables of Gayatri, Vushnika, Anustup, Bruhati, Padavti, Tristup and Jagati categories.





**Starting with "Completeness" end with Completeness":** In Indian methodology of any subject, starting with "Completeness" is ended with "Completeness". Thus, though, mathematically, the numbers appear to start with one (because of westernized thinking), Indians know very well, they start with Zero. 0 to 9 numbers only form basis of decimal number system, therefore, without Zero, if any claim is made for decimal system, how hallow it is can be understood. The limits are prescribed for understanding, comprehension and perfection. Thus, at such a point, only two levels are recognized – lowest and highest, very small and very big, and so on. They are recognized as Zero and Infinity with differing, approaching, overlapping and equal meaning in Indian context. Thus, the two levels merge but still maintaining the two levels. Therefore, in Sanskrit prosody, 2 plays a unique role in deciding the metrics with 1.

**The Importance given to "2" by Pingala:** Pingala in his rules to Sanskrit prosody has given undue importance to the number 2. Typically, he lays down that, "Any power of two throughout divisible by two is equal to two raised to the power of two representing the number of twos the first power is divisible by two", i.e.,  $2^{16} = 2^2$ ,  $2^{32} = 2^2$ ,  $2^{64} = 2^2$  and so on (VIII.407).

In grouping "heavies" and "lights", Pingala adopts a unique method.

If we take Heavy = H and Light = L, for two syllables, we get the combination, as follows:

1. 1H
2. 1L

There are two combinations.

For 3 syllables, we get,

1. 3H
2. 2H, 1L
3. 1H, 2L.
4. 3L.

There are four combinations.

For 4 syllables, we get,

1. 4H
2. 3H, 1L
3. 2H, 2L
4. 1H, 3L
5. 4L.

There are eight combinations.

For 5 syllables, we get,

1. 5H
2. 4H, 1L
3. 3H, 2L.
4. 2H, 3L
5. 1H, 4L
6. 5L

There are sixteen combinations.

Thus, this is the formation of Binomial Numbers, Triangle and Series. They are explained as follows:

$$\begin{aligned}
 (a+b)^0 &= 1 \\
 (a+b)^1 &= a+b \\
 (a+b)^2 &= a^2+2ab+b^2 \\
 (a+b)^3 &= a^3+3a^2b+3ab^2+b^3 \\
 (a+b)^4 &= a^4+4a^3b+6a^2b^2+4ab^3+b^4 \\
 (a+b)^5 &= a^5+5a^4b+10a^3b^2+10a^2b^3+5ab^4+b^5 \\
 (a+b)^6 &= a^6+6a^5b+15a^4b^2+20a^3b^3+15a^2b^4+6ab^5+b^6
 \end{aligned}$$

$$\begin{array}{ccccccc}
 & & & & 1 & & & \\
 & & & & 1 & 1 & & \\
 & & & 1 & 2 & 1 & & \\
 & & 1 & 3 & 3 & 1 & & \\
 & 1 & 4 & 6 & 4 & 1 & & \\
 1 & 10 & 5 & 5 & 10 & 5 & 1 & \\
 1 & 6 & 15 & 20 & 15 & 6 & 1 & 
 \end{array}$$

$$(a+b)^n = a^n + [n!/1!(n-1)!] a^{(n-1)}b + [n(n-1)/2!(n-2)!] a^{n(n-1)}b^2 + [n(n-1)(n-2)/3!(n-3)!] a^{n(n-1)(n-2)}b^3 + [n(n-1)(n-2)(n-3)/4!(n-4)!] a^{n(n-1)(n-2)(n-3)}b^4 + \dots + b^n$$



This has been explained in the context of prosody and similar exposition has been made in Vedic literature about the chanting of mantras with time scale. However, the mathematical significance has to be noted here. This Binomial triangle can rightly be called “Pingala Triangle” and the series ‘Pingala series’. Indian mathematicians have identified the series and arranged the numbers in the form of a pyramid, which they called as *Meruprasthana* and depicted as follows:

1	$2^0$	1
1 1	$2^1$	2
1 2 1	$2^2$	4
1 3 3 1	$2^3$	8
1 4 6 4 1	$2^4$	16
1 5 10 10 5 1	$2^5$	32
1 6 15 20 15 6 1	$2^6$	64
1 7 21 35 35 21 7 1	$2^7$	128
1 8 28 56 70 56 28 8 1	$2^8$	256
1 9 36 84 126 126 84 36 9 1	$2^9$	512
1 10 45 120 210 252 210 120 45 10	$2^{10}$	1024
1 11 55 165 330 462 462 330 165 55 11 1	$2^{11}$	2048
1 12 66 220 495 792 924 792 495 220 66 12 1	$2^{12}$	4096

The basis of writing numbers can be easily explained:

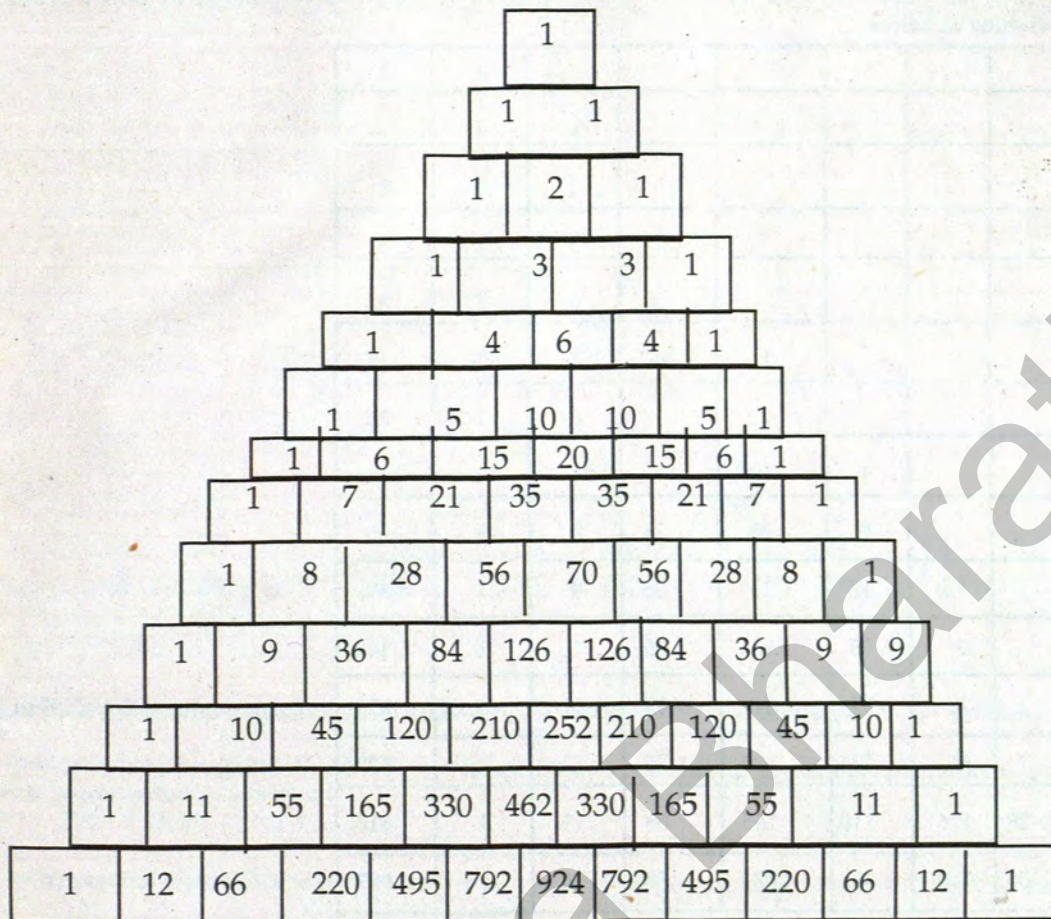
1. Write one in the first square.	1
2. Draw two squares below, write 1, 1	1   1
3. Draw three squares, write 1, 1 in the first and last squares.	1   2   1

Add the adjacent numbers of the above row and write intermediate numbers i.e,  $1+1=2$ .

4. 1, 1+2=3, 3+1=3, 1	1	3	3	1	
5. 1, 1+3=4, 3+3=6, 3+1+4, 1	1	4	6	4	1

Like, this, the squares can be continued with added numbers. The following 'Pingala Triangle' is formed for 12 layers and it is mentioned as 'Meru Prasthana' in the literature.





This clearly proves the basis of two used in the Chanda sutras. However, it may have to be noted that, though "2" has been emphasized, "1" is used and zero adopted for obtaining such results.

In another method, the formation of unique numbers is obtained. With the usual notations of H and L, we continue: For a measure of six quantities can have –

1. 3H, 2H, 2L
2. 1H, 4L
3. 6L.

The first and last can have only one variety.

The second gives  $(4!/(2!2!)) = 6$ .

The third gives  $(5!/(3!)) = 5$ .

Adding, we get  $2 + 6 + 5 = 13$ .

Similarly, 13 quantities can be arranged –

1. 1L, 6H.	The possible varieties are –
2. 3L, 5H	The first, $7!/6! = 7$ ,
3. 5L, 4H	The second, $(8!)/(3!5!) = 56$ ,
4. 7L, 3H	The third, $(9!)/(4!5!) = 126$ ,
5. 9L, 2H	The fourth, $(10!)/(7!3!) = 120$ ,
6. 11L, 1H	The fifth, $(11!)/(9!2!) = 55$ ,
7. 13L	The sixth, $(12!)/(11!) = 12$ .





Adding we get,  $7 + 56 + 126 + 120 = 55 + 12 + 1 = 377$ . This is exhibited as "quantitative cone" as follows. It is also called, *Kandameru*<sup>3</sup> is represented as below:

							1	1
						1	1	2
						2	1	3
					1	3	1	5
					3	4	1	8
			1		6	5	1	13
			4		10	6	1	21
		1		10	15	7	1	34
		5		20	21	8	1	55
		1	15	35	28	9	1	89
		6	35	56	36	10	1	144
	1	21	70	84	45	11	1	233
	7	56	126	120	55	12	1	377
1	28	126	210	165	66	13	1	610
8	84	252	330	220	78	14	1	987

The numbers in the last column are –

1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987 .....etc.

The series is obtained starting with 1, writing 1 and then adding it with the first number ( $1 + 1 = 2$ ), thus, next number is obtained (2), Again, it is added with the previous number ( $2 + 1 = 3$ ), to get the current number (3) and so on.

1, 1, (1+1), (1+2), (2+3), (3+5), (5+8), (8+13), (13+21), (21+34), (34+55), (55+89),  
1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144,.....etc.

They are known as Fibanacci Numbers in the Western world, as they were reportedly found by an Italian merchant and scholar Leonardo of Pisa, also known as Fibanacci (nickname) lived in 12<sup>th</sup> century CE. But, the Numbers are Pingala Numbers, as they were derived from the Pingala Triangle as shown above.

The "syllabic cone" similarly exhibits the formation of the various sub-classes of the syllabic metres. The number of any given sub-class is easily found by the formula  $(n!)/[(n-r)!(r)!]$ . For example, the possible number of varieties of metres of 20 syllables with two heavy and 18 light syllables, we get  $20!/(18!2!) = 190$ .

As  $2^n$  represents the sum of all the varieties of all the sub-classes and as in considering all the sub-classes in which light or heavy syllables occur, we get the possibility,

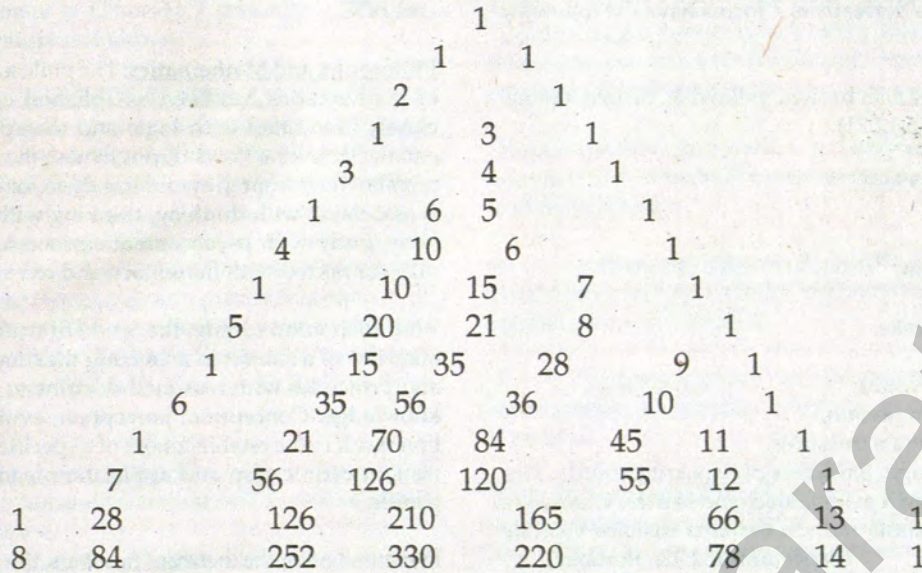
$$S = n!/[(n-1)!] + [n!]/[(n-1)!2!] + [n!]/[(n-3)!3!] + \dots + n!/n! = 2^n - 1.$$

Incidentally, it may be noted the importance of zero given in the series summation. If we put  $n=0$ , we get, the series = 0 and  $n=1$ ,  $S = 1$ .

Thus, the processes involved clearly prove the mathematical background of the Vedic recitation and the Chandas. There have been thousands of manuscripts from Halaudha (c.300 BCE) to medieval commentators on prosody, which give many interesting mathematical figures, number triangles and diagrams. In fact, the yantra-mantra-tantra and Siddha literature too have such figures and one has to research into to correlate the subjects.

There has been another "*Matrameruprastar*"<sup>4</sup>, evidently based on the syllable value attributed.





**Decimal to Binary Conversion Method of Pingala:** Pingala expounds the two properties of "2" as follows:

1. Any power of two throughout divisible by two is equal to two raised to the power of two representing the number of twos the first power is divisible by two",  
i.e,  $2^{16} = 2^4, 2^{32} = 2^5, 2^{64} = 2^6$  and so on.
2. Any other number is reducible to such a number plus some of the powers of two after which the number is not divisible by two.

About the first rule, the significance is already shown above. The second rule clearly points to decimal to binary conversion, which is dealt with as follows:

Taking 51, it is not divisible by 2 initially.  
 But on first and fourth division,  
 $51/2 = 26$  writing 0 and adding 1  
 $26/2 = 13$  writing 1 and continuing division  
 $13/2 = 7$  writing 0 and adding 1  
 $7/2 = 4$  writing 0 and continuing division  
 $4/2 = 2$  writing 1 and continuing division  
 $2/2 = 1$  writing 1 and stop.

Divisor	Dividend	carry
2	51	0
2	26	1
2	13	0
2	7	0
2	4	1
2	2	1
2	1	

So what we get is –

010011

expressing in the multiples of 2,

$$\begin{aligned} 010011 &= (0 \times 2^0) + (1 \times 2^1) + (0 \times 2^2) + (0 \times 2^3) + (1 \times 2^4) + (1 \times 2^5) \\ &= 0 + 2 + 0 + 0 + 16 + 32 \\ &= 50 \end{aligned}$$

adding 1,  $= 50 + 1 = 51$ .

Thus, it is clear evidence, that Pingala devises a method to convert decimal into binary.





**Pingala, what it Denotes:** According to Dictionaries<sup>5</sup>, the word Pingala and its derivatives / forms have the following meanings:

1. **Pingala:** reddish brown, yellowish, brown, tawny (Raguvamsa.12.71).
  2. **Pingalah:**
    - i. the tawny colour,
    - ii. fire,
    - iii. monkey,
    - iv. an ichnemon,
    - v. a small owl,
    - vi. a kind of snake,
  3. **Pingalah (Noun):**
    - i. an attendant on Sun,
    - ii. one of Kubera's treasures,
    - iii. a reputed sage, the father of Sanskrit prosody. His work is known as Pingalachandasstra. Chando gnanna nidhim jadhana makaro velatate (Pancatantra, 2.33, Bombay).
- pingale
4. **Pingalam:**
    - i. brass.
    - ii. Yellow orpiment.
  5. **Pingalaa:**
    - i. a kind of owl.
    - ii. The Sisu tree (Simsapa).
    - iii. A kind of metal.
    - iv. A particular vessel of the body.
    - v. The female elephant of the south.
    - vi. N. of a courtesan, who became remarkable for her piety and virtuous life (the Bhagavata mentions how she and Ajamila were delivered from the trammels of the world).
  6. **Pingalaksha:** an epithet of Siva.

But, its connotation in the context goes beyond this general understanding.

In Yoga, Chakras and physiological studies, Pingala is an important nerve or nervous system.

When Samaveda is quoted, it is usually with the words: "The Chandagos say", Chandagos means "Chandas-singer", and chandas combines in itself the meaning Magic song, Sacred text, and Metre.

The fundamental meaning of the word must be something like rhythmical speech; it might be connected with the root chand = to satisfy, to cause, to please, allure, invite etc.

The different meanings attributed to the word "Pingala" proves its usage and popularity since the Vedic period. Of which, our Pingala is thus is a reputed sage, the father of Sanskrit prosody and author of *Pingalachandasstra*. He is also considered as the brother of Panini, the Sanskrit Grammarian. The date of Panini has been fixed differently based

on different synchronisms ranging from 1000 BCE to 3<sup>rd</sup> cent.BCE.

**Philosophy and Mathematics:** The philosophical background of mathematics has been established one. Philosophy is closely associated with logic and metaphysics. The mathematical thinking flows through these thought processes, the moment they want to symbolize them for others. Philosophy is associated with thinking, thinking with mind, mind with body, body with psychosomatic processes, and they are in turn connected with hereditary and environmental factors.

With such mind setting, the Study of truth involves systematic view of a subject in analyzing the fundamental concepts and principles with reasoned doctrine to produce theory of knowledge. Conception, perception, evolution, and formation result in the establishment of a specific subject. Standardization, codification and application lead to acceptance by people.

In mathematics, the theory of numbers, the processes involved in the combination of numbers, representation of numbers and other processes are subjective and objective too.

**The Chanting of Vedas proves the Music:** The chanting of Vedas proves the best memory power with perfect ability of recollecting and remembrance. The group chanting authenticates the trained method of removal of imperfection, deviation and distortion. The music and metrics registers the knowledge of numbers and mathematics. A trained musician or composer would not perform like modern ones keeping the prepared notes. Indian tradition has been in such a way, they musician engrosses with the spirit of music and thus many times, they are seen singing closing their eyes. This is the state of merging of subjective and objective symbolism. If a child is told to tell tables and the teacher listens to, no script is required. In fact, Indians used to learn by writing on the earth, that, when it is required. The significance of "Aksharabyasam" is to be noted here. It is the initiation of the practice of writing. Kharavela dated near to Asoka had learned all arts by 13 years. How then, the learned Mahavira, Buddha and others learned to become Princes, conditioned to become sanyasis and get enlightenment!

**The Evolution of Chandas:** That Chandas has acquired importance during Vedic period is proved by a rendering of Mundayoka Upanishad (I, I, 5) –

Rigvedo Yajurvedo Samavedo Atharvanah |  
Siksha kalpo vykarnam niruktam **chando** jyotismam |

It explains two forms of Knowledge –

1. Higher Knowledge - The study about Imperishable Brahman.
2. Lower Knowledge - The study of Vedas (Rig, Yajur, Sama and Atharvana) and Vedandas (Phonetics, Ritual, Grammar, Etymology, Metrics and Astronomy) as mentioned. Thus, it has been recognized as one of the Vedangas.





Anunduram Borooh (1850-1889) has traced the origin, evolution and development of Chandas / prosody in the context of Sanskrit literature as follows:

1. **The Vedic Period<sup>6</sup> – Vedic Chandas:** According to him, he noted that, “*Vedic hymns are composed without any knowledge of the law of rhythm*”<sup>7</sup>. This is based on the evolutionary concept. But, it has to be analyzed as to whether such composed poetry has a prosody is incidental or ancillary to the completion of the composition of Vedic hymns with Chandas is the crucial question. Satapata Brahmana’s dealing with different chandas clearly proves that such codification had been there. The specific references to chandas by naming in Yajurveda, Taitreya Samhita, Chandogya Upanishad etc. also prove the fact<sup>8</sup>. This, he divided into three periods:

q **The Age of Even Metres:** The age of even metres contained Anustup, Jagati etc., among which precedence is always given to Gayatri.

q **The Age of Uneven Metres:** The age of uneven metres applied Usnik and Bruhati.

q **The Age of Compound Metres:** The age of compound metres used Atishakvari.

The Vedas, in original form has not been recovered so far. The available hymns have been compiled and codified and presented. Thus, the observation of the division of age of Chandas within Vedic period is only speculative and not definitive.

2. **Ramayana Period<sup>9</sup> – Valmiki Codifies Chandas:** Valmiki discovered the common Anustup and rejected compound metres, thus he differentiated Vedic and common chandas. The broad distinction between the Vedic and the common Anustup is that in the former the four feet are regulated by the same laws while in the latter the two odd feet materially differ. By any estimate, this could have happened c.3100 BCE, if Valmiki is placed before the Mahabharat period.

3. **The Age of Pingala:** Anunduram Borooh meticulously recorded that, “According to his own showing, pingala is not the first writer either of Vedic or of Classical prosody, but, he is among the first, if not the first, to minutely study the construction of both syllabic and quantitative metres”.

4. **The Age of Kalidasa<sup>10</sup>:** Kalidasa laid down simple rule for Anustup. The impact of Kalidasa on Indian literature has been well known.

The date of Kalidasa is placed from the range c.200 BCE to 400 CE confusing with Yavanas, “Nine Gems”, and so on.

5. **The Mauryan Period<sup>11</sup>:** Though, Anunduram Borooh has not specifically mentioned this period, for chronological studies, the two periods are included here, because, according to western / modern scholars, Mauryan period was influenced by the Greeks (with a lot of apocryphal stories like Chandragupta Maurya seeing / meeting Alexander,

when he was a boy etc) for the introduction and development of all arts and sciences in India and the so called “Golden Gupta Period” has been credited with the production of many works with flourishing of many scholars, experts, engineers and scientists.

Though the Mauryan period is dated to c.300 BCE, now, it goes to c.1200-1000 BCE based on megalithic-Iron using culture of Karnataka.

6. **Medieval (Gupta Period)<sup>12</sup>:** So naturally, Poets would have laid down rules of poetry with prosody following the preceding experts.

7. **Modern Period:** With the vast coverage of available literature by the scholars, they identified and compiled the Chandas.

**Date of Vedas and Pingala Sastra:** The date of Vedas differs and varies from before 8000 BCE to 2500 BCE depending upon the different synchronisms, astronomical notings and above all the question of script and the development of language out of it and thereafter. If Vedas were dated to such widely differing periods or ranges, why the Vedic people should have taken 7500 or 2000 years to produce a treatise about the prosody around 500 BCE? That the Vedic hymns had already been there in such metric form proves the existence of such codified and established rules and regulations before Chanda Sastra i.e., before c.8000 to 2500 BCE period. The argument that literature should have been there and then only, grammar could have come, is not new one, but too what extent it is historically correct has to be analyzed. Therefore, with the above discussion, it is evident that the Chandas had been there during the Vedic period itself i.e., before 8000 BCE. Pingala himself has recorded its usage before him. Hence, the date of Pingala can be placed c.1500-1000 BCE.

**Contradictions and Historicity:** In Indian context, the scholars have been taking contradicting, self-denying, paradoxical stands during the last 100 to 150 years. Initially, they traced all origins to India praising India like anything. Then, they made sudden somersault denying all credit and started propounding that India derived everything from others, particularly after Alexander’s invasion. Even in the case of decipherment of Indus script, they have not come to any conclusion, in spite of scientific attempts made. Imposing “Aryan-Dravidian” controversy over the research, they divided the Indian scholarship into perpetual warring groups. They have created enough barriers and hurdles for them to cross and come to any consensus.

Therefore, taking archaeological evidences, Indian historians have to come to conclusion as otherwise, it is absurd that the people of other civilizations were dealing with India, Indian goods etc., without Indians or  
 P Indians with language without script,  
 P literature without grammar,  
 P numbers without mathematics,  
 P philosophy without logic, geometrical figures (yagnasalas) without geometry,





P weights and measures without trade,  
 P ships without seafaring,  
 P thousands of inscriptions without sense of history,  
 P having different eras but without chronology  
 P knowing planets and stars but without their names  
 and so on.

Thus, the available material evidences cannot be made contradicted evidences, negating the available evidences themselves. Negative evidence cannot be evidence, when corroborative and correlating evidences point to the existence of such denied evidence.

**Conclusion:** The modern method of constructing historical perspective of Indian civilization, taking only material evidence ignoring the non-material evidences like music, philosophy, logic, mathematics and their skill exhibited and preserved in the literature cannot be a correct one. As nothing comes from vacuum, such a refined literature with data and information could not have been produced by a hoard of barbarians, roaming nomads, itinerant bards, illiterate scribes, and others with their sheep and cows searching for the pastures and meadows, as has been projected by learned archaeologists and historians. This has been recorded in the minds of present-day Indian researchers and they have been proceeding in the same way ignoring the scientific study of development of mind, brain, body and their inter-related activities and processes, the ability of producing structured, systematic and standard literature, mention of such methodology in the literature itself, mention of psycho-somatic development and processes in the literature. These are the evidences, which cannot be produced without established, instituted material evidences. No scholar can ignore a field or subject, just because, it is beyond his comprehension or scope. Asserting that their methodology has been scientific, scientific evidences cannot be ignored. Thus, based on the above discussion, the following conclusions are drawn:

1. The philosophical, psychological and logical development must have taken place before the advent of the Vedas, thus, the "philosophical period" goes back to c.8000-2500 BCE.
2. The "mathematical period" comes thereafter with the established number system and their application to poetry and altars.
3. The "poetical / literary period" follows.
4. If the "evolutionary scale" is taken into account, archaeologically, Indian man could have achieved it after 30,000 to 20,000 YBP based on the Madhya Pradesh Cave-men, who drew the cave paintings and the Pallavararam Axeman.
5. Thus, the philosophical to mathematical to literary periods would have progressed in phased manner. Under the circumstances, the date of Chandasutras could be before c.2500 BCE period.
6. Such civilized and advanced-minded people would

have perished with the disappearance of Saraswati, IVC civilizations due to other natural catastrophes.

7. Even the archaeological evidences obtained have been mixed one at several places. Wherever, geological evidences have been found dated to millions of years, archaeological evidences have not been correlated and studied. The literary evidences describing such antiquity is also ignored.

8. Thus, the attempt of starting everything with Mauryan period is not tenable, as evidences are mounting (megalithic Iron users of Karnataka going back to c.1200-1000 BCE with Asokan inscriptions, Sri Lankan Brahmi script going back to c.600 BCE etc.) for the pre-Mauryan period, hitherto not explained by historians.

9. The western scholars determined the dates of Egyptian, Assyrian, Babylonian and others only with astronomical methods and they are followed in spite of difference of opinion and contradictions. The later found archaeological evidences are only correlated and corroborated with such constructed chronology. Therefore, in the Indian context, scholars cannot take double standards in disparaging such methodology.

10. As in the case of Indian astronomy, the works Sidhantas, Karanas are there covering three periods, the Vedic literature too must cover phased manner. Therefore, The Chanda Sutras must have been there before Vedic period and Pingala might have condensed into aphorisms for progeny during his period.

#### Notes and References

1. There has been undue interest shown about Pingala by the westerners recently, because, his aphorisms talk only about mathematics, series, logical sequences, number diagrams and so on, that too, dealing with notes, vibrations and sound propagation along with prosody and music.  
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2. Anundoram Baorooah, *Prosody*, Publication Board, Guahati, Assam, 1975.
3. Ibid, Stikam Vruttaratnakaram, Prastaradhyaya, p.79.
4. Ibid, Stikam Vruttaratnakaram, Prastaradhyaya, p.78.
5. V. P. Apte, Sanskrit Dictionary, etc.
6. Vedic period – According to different authorities, it is dated to c.10,000 BCE to 2500 BCE.





7. Anundoram Baarooah, opt.cit,
8. Antiquity of Chandas – The period ranges from c.2000 to c.200 BCE.
9. Ramayana Period – It also varies from Tretayuga to the present Current Era. i.e, from c.1,750,000 BCE to 4430 BCE.
10. C. V. Vaidya, The Pandyas and the Date of Kalidasa, Annals of Bhandarkar Oriental Research Institute (ABORI), Vol.2, 1921, pp.63-68  
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H. A. Shah, Kautilya and Kalidasa, QJMS, Vol.11, pp.138-145 and Vol.12, pp.238-248.

The date of Patanjali differs from c.1000 BCE to 400CE.

K. B. Pathak, The Age of Panini and Sanskrit as a Spoken Language, ABORI, Vol.11, 1929, pp.59-83. He fixes the date to "last quarter of 7<sup>th</sup> cen.BC" i.e, c.675 BCE.

11. Mauryan period. Scholars date to c.1400 BCE and c.300 BCE based on Megalithic / Iron evidences and Asokan synchronism.
12. Gupta Period – Here also one group dates to c.300 BCE and another to 3<sup>rd</sup>-4<sup>th</sup> Cent.CE.

Much fuss is made about the origin of pentatonic (five-tone), heptatonic (seven-tone) scales. But, Vedas start with "one" and develops into others. Here, only Chanadas play a role. Interestingly, the books and encyclopedias neither mention Vedas or the Indian notes / music, but delves upon the Greek music, its relation with poetry and literature. Coming to Pythagoras of Samos (c.6<sup>th</sup> cent.BCE), they mention about his discovery of the ratios of all the intervals recognized as consonant could be expressed numerically by the figures 1, 2, 3 and 4. Showing first that the octave is represented by the ration 2:1, the fifth by 3:2, and the fourth by 4:3, he proceeded to build up the whole diatonic scale in the following way. Twofifths, as C-G / Paranete-Lichanos, and G-d, added together, give the ninth, C-d, That is, in numerical terms:  $3/2 \times 3/2 = 9/4$ . However, they do not mention that Pythagorus visited India to learn. They do not mention about any "metric work for music" like Chanda Sastra in Greek. They also talk about Ionian Harmony, which is made of "highest" and "lowest" tone produced in a string. They are –

Sl.No	Notation	Name	Meaning	Explanation
1	D	Nete	"Lowest" string – really the highest note	The terms "highest" and "lowest" applied to the strings of the lyre as it was in playing position. The longest strings, or at any rate those in pitch, as in harp, were away from the performer, and held uppermost.
2	C	Paranete		
3	Bb	Trite	Next to Nete	
4	A	Mese	Third string	
5	G	Lichanos	Middle string	
6	F	Parhypate	"First-finger" string	
7	E	Hypate	Next to the highest "Highest" string – really the lowest note	